Centre Number	Candidate Number

Candidate Name _____

International General Certificate of Secondary Education

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

PHYSICS 0625/3

PAPER 3

Thursday **16 NOVEMBER 1999** Morning 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

1 Fig. 1.1 shows the outline of a machine for driving steel pillars (called piles) into the ground.

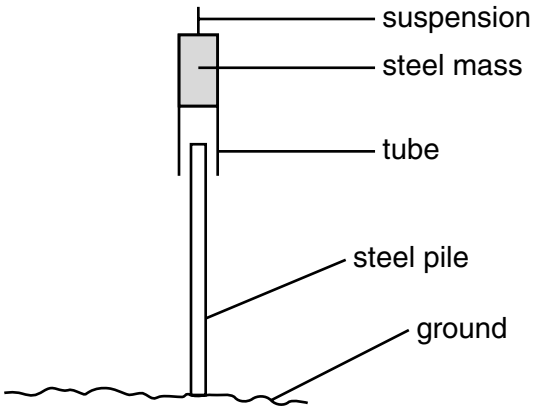

Fig. 1.1

The steel mass is raised by an electric motor and then falls under gravity.
The falling steel has a mass of 200 kg and falls a distance of 6.0 m.

(a) The acceleration of free fall is 10 m/s^2. Calculate

(i) the potential energy gained by the mass each time it is raised,

potential energy gained = ...

(ii) the maximum speed at which the mass hits the pile.

speed = ...
[7]

(b) When the mass hits the pile, it has kinetic energy. This energy is transformed into other forms of energy as the speed of the falling mass rapidly reduces to zero. As this happens, the pile is forced a small distance into the ground.

(i) State the energy conversions which take place, starting from the kinetic energy of the falling mass.

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(ii) Explain how a large force is produced when the pile is driven a short distance into the ground.

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[8]

(c) In raising the steel mass 6.0 m, the electric motor uses more energy than that calculated in **(a)(i)**.

Write down and explain **two** causes of this higher energy requirement.

1. .....

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2. .....

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.....[4]

(d) The equipment design is changed so that when the mass falls once, the pile is driven further into the ground than before the design was changed.

Suggest **three** changes that could be made to do this.

1. .....

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2. .....

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3. .....

.....[3]

2 Fig. 2.1 shows a piece of apparatus which could be used to find the specific heat capacity of a metal at high temperatures.

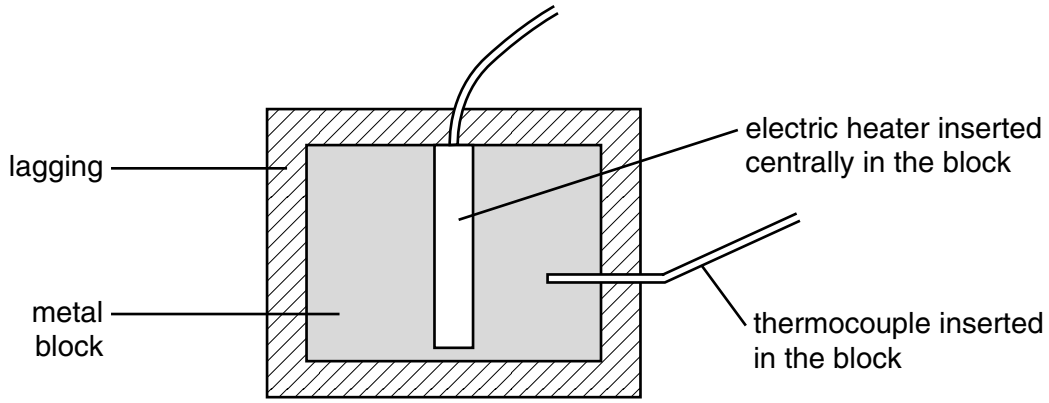

Fig. 2.1

Results from an experiment using the apparatus are recorded as follows:
mass of the metal block, 1.0 kg;
power of the heater, 200 W;
time for which the heater is switched on, 2.5 minutes (150 s);
rise in temperature during this time, from 160 °C to 210 °C.

(a) Describe the experimental steps which were taken to obtain these results.

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.....[3]

(b) Use the results to calculate an average value for the specific heat capacity of the metal over this temperature range.

specific heat capacity = ... [4]

(c) The temperature of the metal was measured by using a thermocouple.

(i) Draw a labelled diagram of a thermocouple being used as a thermometer.

(ii) Describe the action of a thermocouple when measuring a temperature change.

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(iii) Suggest two reasons why use of a thermocouple might have an advantage over a mercury-in-glass thermometer.

1. .....

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2. .....

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[6]

[Turn over

3 Fig. 3.1 shows a ray of light, PQRS, passing along a simple optical fibre.

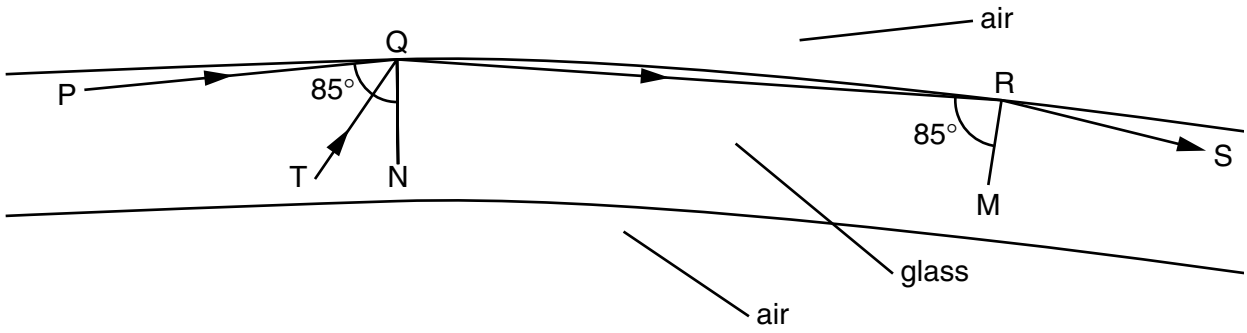

Fig. 3.1

(a) Calculate the angle between the ray PQ and the ray RS.

angle = ... [2]

(b) Explain why the ray PQ does not leave the fibre at Q.

.....

.....

.....[2]

(c) Another ray TQ also strikes the surface at Q.
The refractive index of the glass is 1.50.

(i) Calculate the critical angle for this glass.

critical angle = ...

(ii) Explain why the ray TQ leaves the fibre.

.....

.....

.....
[4]

(d) The light waves travelling towards Q are monochromatic and have a frequency of 4×10^{14} Hz and a wavelength of 5×10^{-7} m.

(i) What is meant by *monochromatic*?

.....

.....

(ii) Calculate the speed of these waves in the glass.

speed = ...

(iii) Waves travelling along TQ pass into the air. The refractive index of the glass is 1.50.

Write down an expression from which the speed of the light waves in air could be found.

.....[5]

4 Fig. 4.1 is a block diagram of an electrical generating and distribution system.

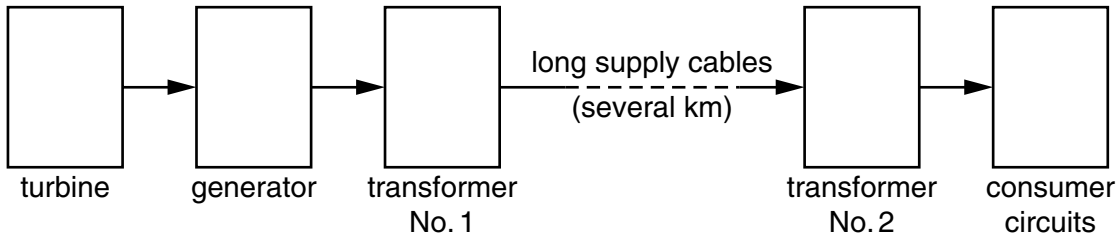

Fig. 4.1

(a) The generator produces an e.m.f. by a process called electromagnetic induction.

(i) Name two factors and state how they are changed in order to increase the output e.m.f. of the generator.

1. .....

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2. .....

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(ii) Explain what is meant by the statement 'the induced e.m.f. acts in such a direction as to produce effects to oppose the change causing it'.

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[6]

(b) (i) Fig. 4.2 shows the basic parts of transformer No. 1 which is 100% efficient.

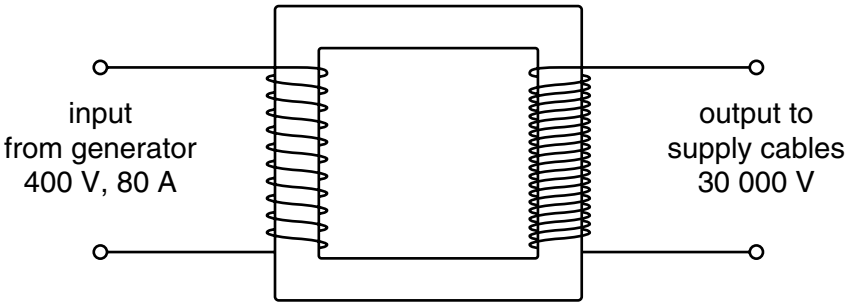

Fig. 4.2

Using the information on Fig 4.2, calculate the current in the supply cables.

current = ...

(ii) Describe the function of transformer No. 2.

.....

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(iii) Explain why the use of the two transformers results in a big reduction in power loss in the supply cables.

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[6]

(c) Fig. 4.3 shows one of the consumer circuits with three electrical appliances R, S and T, connected into the circuit.

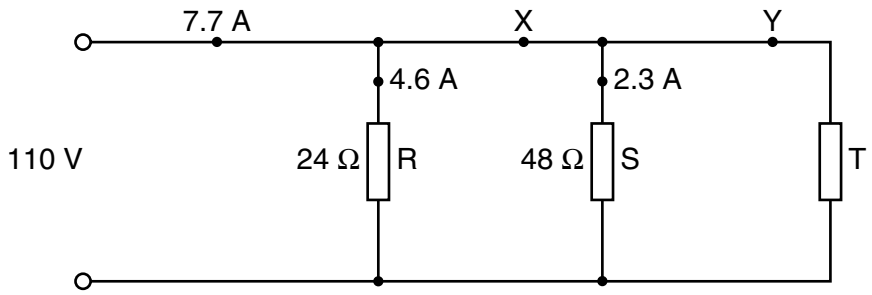

Fig. 4.3

Using the current, voltage and resistance values shown on Fig. 4.3, calculate

(i) the current at point X and at point Y,

current at X = ...

current at Y = ...

(ii) the resistance of appliance T,

resistance = ...

(iii) the combined resistance of appliances R and S,

resistance = ...

(iv) the power developed in appliance R,

power = ...

(v) the energy converted by the appliance S in 2 minutes (120 s).

energy converted = ...

[10]

5 Lengths of steel may be joined by welding them together, as iillustrated in Fig 5.1.

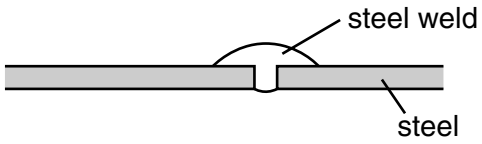

Fig. 5.1

A liquid radioactive source is to be used to test that the welds joining lengths of steel pipe are of equal thickness.

The diameter of the pipes is 120 mm and the pipe wall thickness is 5 mm.

The liquid runs through the pipes whilst a suitable detector moves around the outside of the joints.

(a) With the aid of a labelled diagram, explain how this method detects places where the welds are thinner than 5 mm.

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.....[3]

(b) In order to find out the most suitable type of isotope for this purpose, tests were carried out on the ability of the radiations from an α-emitter, a β-emitter and a γ-emitter to penetrate steel.

(i) Write down what you would expect to be the results of these tests.

α-emitter .....

.....

β-emitter .....

.....

γ-emitter .....

.....

(ii) State and explain which type of emitter would be most useful for testing these welds.

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[4]

(c) Describe three precautions which should be taken to ensure the safety of the operator who is making these tests.

1. .....

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2. .....

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3. .....

.....[3]